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San Francisco, California
1952

THE PAN-PACIFIC ENTOMOLOGIST

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The Pan-Pacific Entomologist

Vol. XXVIII July, 1952 No. 3

BRIGHTON CLARK CAIN

The passing of B. C. Cain on May 19, 1951, is a severe loss to western entomology. "Bugs" Cain, as he was known to generations of Boy Scouts, graduated in Entomology at Stanford University in 1923. He took a Master's Degree at Stanford devoting his research to the biology of the European earwig which, at that time, was a recent immigrant to California.

Mr. Cain was not a professional entomologist. He never published a paper in the field, and, although he kept up his membership in the Pacific Coast Entomological Society (1923 to the time of his death), he rarely attended meetings.

For a quarter of a century, "Bugs" Cain devoted himself exclusively to young people. As Naturalist of the Oakland Council, Boy Scouts of America, he inspired countless boys at Dimond Camp in the Oakland Hills and at Dimond "O" Camp near Yosemite. His enthusiasm was contagious. How many of his proteges actually went on to careers in science may never be known but at least one group of six professional entomologists arranged an anniversary dinner in his honor some years ago and bound their scientific publications into a sizable volume which they dedicated to him.

Since his death a "Bugs" Cain Memorial Fund has been raised by grateful friends throughout the world. Upon conclusion of the drive, the funds will be delivered to the City of Oakland for the construction of a Nature Study Building in Lakeside Park. This seems particularly appropriate because Lakeside Park was the place where scouts convened at an early hour on many a cold morning for bird hikes. In retrospect, one can say of "Bugs" Cain that here was a truly great man who lived not for himself but for the inspiration that he gave to others.—ROBERT L. USINGER.

NEW BOMBYLIID FLIES REARED FROM ANTHOPHORID BEES

(Diptera: Brachycera)

FRANK R. COLE
Redlands, California

While studying colonies of anthophorid bees, *Diadasia consociata* Timberlake, and *D. bituberculata* (Cresson) in California, E. G. Linsley, J. W. MacSwain and R. F. Smith of the University of California reared three species of bombyliids from the nests of these bees. The flies were sent to me for identification, and all proved to be undescribed.

Two of these flies are rather closely related species belonging tc the genus *Villa* (subgenus *Paravilla* of Painter) in the now generally accepted classification of the family; the third parasite is an interesting species of the genus *Anthrax* (a group better known in the literature under the generic names *Argyramoeba* and *Spogostylum)*, very closely related to *Argyramoeba daphne* of Osten Sacken. I have compared these flies with various related forms in my collection in the California Insect Survey and collection of the University of California.

Many of the bombyliid flies are well known parasites of bees and wasps, or have been discovered living in their nests as inquilines. Fabre has written a most interesting account of the Anthrax Fly *(Anthrax trifasciata)* and its relation to the "wall bee," *Chalcidoma muraria* Retzius, in France. *Villa edititia* Say, related to the two species of *Villa* described in this paper, has been reported as a parasite of ground nesting bees of the genus *Anthophora*.

Anthrax nidicola Cole, new species

(Figure 1)

The basic body color is black, but the species has a gray appearance. The wings are largely hyaline, with a few small, pale clouds; an extra crossvein forms three submarginal cells.

Head black, with a dull, iron gray "finish" (the texture too fine to be termed pollen), more hoary on the sides. Face and frons with short, erect, black hair, mixed with some yellowish at sides of oral margin; yellowish tomentum visible between this hair; tomentum of occiput finer and paler. Antennae satiny, gray black, of characteristic form, with black hairs on segments I and II. *Mesonotum* and scutellum gray black in color, dorsum covered with short, fine, dull golden tomentum, coarser and more dense on scutellum, on mesonotum appearing as broad stripes; some sparse black pile and black bristles on sides of mesonotum and on scutellum. The ruff is yellowish to white, with a few black hairs above. Pleura gray black, with

long bushy pile, which ranges from white to golden in color. Coxae with mixed black and yellowish bristles. *Abdomen* gray black, slightly more shining than thorax; as wide as thorax at base, tapering as in typical species of the genus; first tergite slightly longer than III, IV or V, second tergite longer than any other two tergites combined; first segment tufted with white hair on each side. In well preserved specimens (which are rare) there is

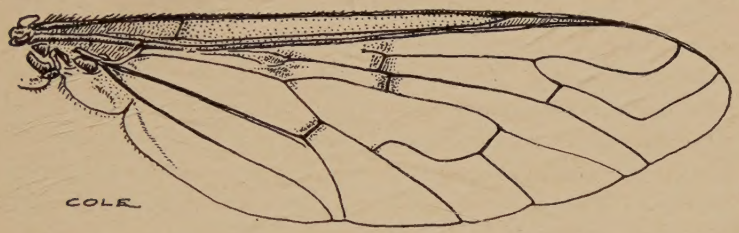

Fig. 1—Wing of *Anthrax nidicola* Cole.

a rather dense covering of tomentum on the abdomen, denser on sides and near apex, most of which is shining, snowy white, but golden brown at base of second tergite, and a few brown scales evident on third and fourth. Dorsum of abdomen with sparse, black, rather recumbent bristly hairs. Incisures yellowish red, widening apically (in a few specimens tergites VI and VII mostly reddish). Hypopygium largely reddish, the large dorsal valves semi-translucent, pale mahogany, the ventral plate with strong black hairs. Venter largely gray black, posterior margins of sternites reddish, and with a covering of whitish tomentum and sparse golden pile. Stem of halteres yellowish brown, knob honey yellow, tipped with ivory. *Femora* and last four tarsal segments black, the tibiae reddish. Bristles of the legs black. Pulvilli well developed. Legs with pale tomentum, the fish-scale tomentum of femora silvery. Wing (fig. 1) largely hyaline, pale brown at extreme base; veins heavy, black; costal cell grayish; a square blackish brown spot at middle of first basal cell (2nd R), and a brown spot on anterior crossvein and on the squared base of first submarginal (3rd R) where there is a stump of a vein; very narrow brown clouds at bases of third and fourth posterior cells. Three submarginal cells in all specimens examined, as in the type, a strong crossvein connecting the anterior branch of third vein (R_4) with the second vein (R_{2+3}). Length 6.5 mm.

Female. With the same basic coloring and marking as in the male. Less pile on the pleura, and pile of coxae more white. Dorsum of the abdomen mottled with white tomentose patches, and with spots of black tomentum tergites II, III and IV; some brownish tomentum scattered on dorsum. More blackish pile on abdomen than in male, some black pile mixed with the yellowish on venter. Genital segment with close-set, incurved, golden pile. Length 7 to 8 mm.

Holotype: Male from TRACY, SAN JOAQUIN COUNTY, CALIFORNIA, June 7, 1949, collected by J. W. MacSwain; female allotype from Palo Verde, Imperial County, California, April 8, 1949 (P. D. Hurd); fifteen male paratypes, Tracy, California, May 3 to June

21 (E. G. Linsley, J. W. MacSwain, R. F. Smith), also one from Cottonwood Springs, Riverside County, California, April 26 (L. W. Quate), and two collected at Redlands, San Bernardino County, California, September, 1914 (F. R. Cole).

This interesting species has near relatives in *Anthrax isis* (Meigen) and *Anthrax binotata* (Meigen), from Africa and Europe. It is very close to Osten Sacken's *daphne*, described at length and figured (wing) in volume I of the Biologia Centrali-Americana, but this species is usually larger, has only two submarginal cells, and most of my specimens are more dull brownish in general color, with smaller wing clouds, etc. I have a small specimen of *daphne* from Santa Fe, New Mexico; Osten Sacken stated: "Length 10 millim., but much smaller specimens occur."

Villa apicola Cole, new species

Body dull, gray black, first two antennal joints, face, femora, tibiae and bases of tarsi yellowish in ground color. Structural characters rather typical of the subgenus *Paravilla*. Wings brown on basal half, the color slanting from end of costal cell through middle of discal cell and into the apical fourth of the anal cell.

Male. First antennal joint about twice the length of second, the third joint long conical at base, this black basal portion half the length of third joint and equal to first and second joints combined. Frons at vertex little wider than base of third antennal joint. Face projecting, but not truly long conical; the face and frons with ochre yellow tomentum and with short proclinate black bristles; dense tomentum of occiput ochre yellow. The proboscis is not projecting. *Pile* and tomentum of thorax yellow to golden, fairly short; whitish pile over wing base; pile of pleura mostly longer, yellow to whitish yellow. Scutellum black, yellow tomentose and pilose. The thoracic bristles yellow. The halteres yellowish. *Abdomen* on dorsum with a dense covering of fine golden yellow tomentum. Abdominal pile sparse, yellow, denser and more bushy on sides and at base. Venter reddish on apical half, all the pile and tomentum yellowish. Abdomen without black tomentum. *Femora* and tibiae with yellow, appressed tomentum; basal half of tarsi yellow in ground color, apical joints blackened. Front claws almost equal to others in length, the front tibiae noticeably bristled. Wings more than half gray hyaline; brownish basal color runs with a vague outline from tip of costal cell back through basal third of first posterior cell, the middle of discal cell, and bases of third and fourth posterior cells and apex of anal cell; the auxiliary cell is broadly margined gray hyaline; veins are black, strong and with no indication of three submarginal cells, a character we find in the related species described in the paragraphs following this; the anterior crossvein is about opposite the middle of the discal cell. Length 6 mm.

Female—Similar to the male. The frons is broader at the vertex (being twice the width of the third antennal joint at its base and about twice the

width of the ocellar tubercle). The face is more typically conical than in the male. The pile on head and mesonotum is about the same as on male; the tomentum on the occiput is more whitish, and there is whitish tomentum on the sides of the long second abdominal tergite.

Holotype: Male, *allotype* female, and paratypes from TRACY, SAN JOAQUIN COUNTY, CALIFORNIA, April 26, 1949, reared from cells of the bee *Diadasia consociata* Timberlake.

Villa (Paravilla) tricellula Cole, new species

Body black, except for the reddish color of first antennal joint and genitalia, and portions of face, femora and tibiae. The principal characters are typical of Painter's subgenus *Paravilla*, which was based on *edititiodes* Painter (Jour. Kans. Ent. Soc., VI, p. 10). The wings are brown on the anterior proximal portion, and on the anterior and posterior crossveins. There are three submarginal cells (See Fig. 2).

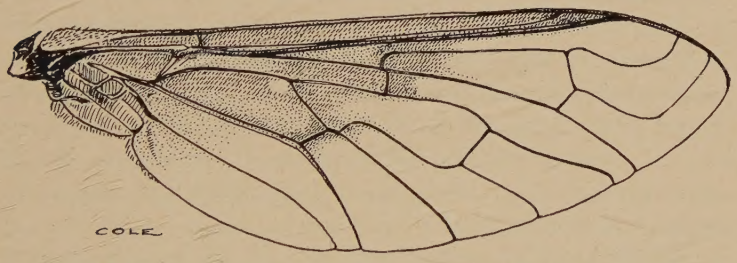

Fig. 2. Wing of *Villa (Paravilla) tricellula* Cole.

Female—The ground color of most of the body is black, gray dusted to semi-shining. First antennal joint about one-third longer than second, dull reddish in color, second joint with a slight reddish tinge (not noticeable in some specimens). Third antennal joint black, long conical at base, the styliform portion slightly longer than base. The orange yellow face is projecting and conical, the proboscis extending only slightly beyond oral margin. Frons and face with yellowish tomentum and short black pile, the pile erect on frons and more abundant on lower third; tomentum of vertex yellowish, silvery white on the rest of the occiput. *Pile* and tomentum of thorax largely dull yellowish, some white and more shining on scutellum, above wing base and on lower pleura. Bristles of mesonotum and scutellum golden yellow. Yellowish pile longest on collar or ruff and on mesopleura. Halteres yellowish. *Abdomen* gray black, semi-shining, rather densely pilose, and with a covering of narrow tomentum-scales in well preserved specimens; the pile mostly white anteriorly, where it is longest and semi-erect. Narrow posterior borders of black, bristly pile on second and following segments, this pile more abundant posteriorly; some of tomentum on dorsum straw yellow. Pile of first sternite white, the balance of venter yellow pilose and tomentose. *Femora* yellow; tibiae yellow, darker at tips, the tarsi blackish. The bristles

of legs black, quite apparent on front tibiae. Front claws as large as others. Femora and tibiae with dense yellowish tomentum. *Wings* are largely hyaline, gray brown on anterior proximal portion, and not filling much of the basal portion of discal cell; discal, anal and auxiliary cells largely hyaline in the type (slightly more clouded in some specimens); veins heavy and black; a strong crossvein connects third and fourth veins (R_{2+3} and R_4), forming three submarginal cells in all of the type series. There are strong clouds on anterior crossvein (r-m) and posterior crossvein (m). *Length* 10 mm.

Holotype: Female and 16 paratypes were reared from cells of *Diadasia bituberculata* (Cresson) collected by E. G. Linsley and J. W. MacSwain at Barrett Springs, San Diego County, California, on April 20, 1950.

It is most unusual to rear a group of seventeen parasite specimens (at least in Diptera), all of one sex. Among the paratypes is a freak specimen, having one wing with several spur veins along Rs and extra crossveins forming three discal cells.

I have what I take to be *Villa (Paravilla) edititoides* Painter from Lassen County, California (also some related forms which are undescribed), and this species has much more of the wing shaded brown. Painter placed in his subgenus *Paravilla* the following species: *consul* (Osten Sacken), *cuniculus* (Osten Sacken), *pallita* (Loew), *diagonalis* (Loew), *obscura* (Coquillett), *lacunaris* (Coquillett and *nemakogensis* (Graenicher).

Specimens of a closely related and apparently undescribed fly were taken in San Antonio Valley, Santa Clara County, September 14, by P. D. Hurd; this form has *two* submarginal cells, the wings slightly more infuscated, abdomen with white tomentum and less black, bristly pile, and with small triangles of black tomentum on second, third and fourth tergites.

Book Notice

THE SCRUB-TYPHUS AND SCRUB-ITCH MITES (TROMBICULIDAE: ACARINA) OF THE ASIATIC-PACIFIC REGION. By H. Womersley. Published by the South Australian Museum as Vol. X of the Museum Records. Paper covers. Part I, 436 pp., 4 text figs.; Part II, 240 pp. containing 120 pls. of line drawings opposed by the legends.

According to a press notice: "The family, subfamily and genera are fully keyed. The classification hitherto largely based on larvae is revised on adult and nymphal characters. . . . Total species mentioned . . . 255." Price 3 pounds, 3 shillings (Australian). The issue is limited; orders should be sent to The Director, South Australian Museum, North Terrace, Adelaide, South Australia.

NOTES ON SOME EFFECTS OF PARASITISM UPON A SMALL POPULATION OF DIADASIA BITUBERCULATA (CRESSON)

(Hymenoptera: Anthophoridae)

E. G. LINSLEY AND J. W. MACSWAIN
University of California, Berkeley

On several occasions, in the course of studies of the biology of bees, the writers have found abandoned nesting sites of gregarious ground-nesting species. In some cases the disappearance of the bees could be attributed to an extended period of drought or some other physical factor in the environment. However, a few cases did not appear explicable on any such basis and, since abundant evidence was present that there had been a high incidence of parasites and predators in the population, it was suspected that biotic factors might have played an important role in the disappearance of the bees. It may therefore be of interest to report observations on the effects of parasitism on a population of *Diadasia bituberculata* (Cresson), in which the net result was to reduce the population to such a low level as to virtually exterminate it.

Diadasia biturberculata is a gregarious, ground-nesting anthophorid, which collects pollen from *Convolvulus arvensis* Linnaeus. Its nesting habits are similar to those of *D. consociata* Timberlake which will be described elsewhere (Linsley, MacSwain & Smith, 1952a) although the pupal period is apparently shorter (23 - 25 days). The nesting site involved in the following observations extended for about 50 feet along a hard-packed, rarely used dirt road near Barrett Springs, San Diego County, California. When the site was discovered on April 20, 1950, there were indications that large numbers of cells had been provisioned during the previous season although but two male bees were in evidence about the area. A sample of 337 cells was removed at this time. These were examined on April 25 with the results indicated in Table I. When the site was revisited in July 1950, no adult bees were evident and sampling failed to yield any living bee larvae or cell series which had been provisioned during the 1950 season.

Molds, as is often the case with ground nesting bees, took a large toll in bee cells. In the sample examined 34 per cent of the cells contained mold which had apparently destroyed the cell con-

tents. *Aspergillus flavus* Link[1] was the prevalent species, although several species of *Rhizopus*[1] were also present. These last may have been secondary invaders and may be saprophytic.

Villa (Paravilla) tricellula Cole[2] was by far the most important insect parasite encountered in the nest area. Twenty-seven per cent of the cells examined contained larvae or pupae of this species. When allowance is made for the bombyliid larvae destroyed directly or indirectly by mold, it is obvious that the number of cells originally infested was much higher. Actually, *Villa* succeeded in destroying 41 per cent of those bee larvae in our sample which were not destroyed by mold. Undoubtedly many of these larvae had also been attacked by *Rhipiphorus* or *Photopsis*, both of which would also be destroyed by *Villa*.

Rhipiphorus diadasiae Linsley and MacSwain destroyed bee larvae in 18.5 per cent of the non-moldy cells examined, although this figure would be higher if bee larvae containing this parasite which were destroyed by *Villa*, *Photopsis* or *Lytta* could be determined. From these figures involved it is estimated that approximately thirty per cent of all cells were originally infested with Rhipiphorid larvae. The feeding habits of this species are like those to be reported in detail elsewhere for *Rhipiphorus smithi* Linsley and MacSwain, (LINSLEY, MACSWAIN AND SMITH, 1952b). The external feeding period, period between completion of feeding and pupation, as well as the pupal period were obtained for 10 specimens of *R. diadasiae*. These periods in sequence averaged 6.3 days (range 6-8); 4.9 days (range 3-7); and 12.9 days (range 11-15). The fragmentary biological observations on this species differ markedly from the more complete study of *R. smithi* in one important detail. In *R. smithi* over 99 per cent of the adult beetles escaped from the soil whereas a high percentage of *R. diadasiae* failed to reach the surface. However, this latter circumstance might well have been due to some purely local condition where the study was made.

Photopsis auraria Blake[3] has been reported previously as a parasite of *Anthophora linsleyi* Timberlake (Linsley and McSwain, 1942). As far as could be determined its habits as a parasite of

[1]Identified by E. A. Steinhaus, Division of Biological Control, University of California, Berkeley, California.
[2]Identified by F. R. Cole, Redlands, California.
[3]Identified by C. E. Mickel.

Table I. — Parasites and predators in a nest sample of *Diadasia bituberculata* (Cresson) examined April 25, 1950[1].

Material examined and stages present	Number of cells	Per cent of total	Per cent of non-moldy cells (248)
Cells sampled	377	100.0	100.0
Unparasitized *Diadasia bituberculata*			
overwintering larvae	32	12.5	
adults	15		21.8
Bees (adults) dead from unknown causes	7	1.9	
Cell contents destroyed by molds	129	34.2	
Villa (Paravilla) tricellula (Bombyliidae)			
larvae	84		
pupae (including 7 dead)	18	27.1	41.1
Rhipiphorus diadasiae (Rhipiphoridae)			
larvae (endoparasitic first instar)	12		
pupae	2	12.1	18.5
adults (including 26 dead)	32		
Photopsis auraria (Mutillidae)			
larvae	5		
pupae	8	5.3	8.1
adults (including 3 dead)	7		
Photopsis sp. (Mutillidae)			
larvae	11	2.9	4.4
Lytta melaena (Meloidae)			
larvae	11	4.0	6.1
pupae	4		

[1]All identifications based upon reared adults.

D. bituberculata are as described for *Anthophora*. Seven females and six males were ultimately reared. The females were identified by C. E. Mickel as *P. auraria* Blake, 1879 and the males as *P. nebulosa* Blake, 1886. On the basis of habits, cocoon structure, and coincidence of emergence we regard them as a single species, *Photopsis auraria* Blake, a conclusion also suggested by Dr. Mickel *(in*

litt.). Emergence dates for the females ranged from April 20 to May 23, the males, with one exception, from April 28 to May 18. One male, however, did not pupate until May 18 and did not transform until June 19. 5.3 per cent of the cells examined contained *P. auraria*, which had parasitized 8.1 per cent of the bee larvae not killed by mold, *Villa* or *Lytta*.

Photopsis sp., represented by 11 larvae from which six females were ultimately reared, is smaller than *P. auraria*, the larvae construct a more delicate cocoon, and adults did not emerge until July. Whether these specimens were retarded in development by our methods of laboratory rearing or whether they actually represent a different species remains to be determined. This form was found in 2.9 per cent of the cells examined and had destroyed 4.4 per cent of the bee larvae which were not destroyed by mold, bombyliids or meloids.

Lytta melaena (LeConte) may have had a greater effect on the host bee than that indicated in Table I. The fifteen larvae and pupae were found in resting cells removed from the series upon which the earlier larval stages had fed. Since larvae of several species of this genus have been found destroying one or more cells, depending upon the size of the host attacked, it is possible that the larvae of this species may have destroyed two cells each in completing their development. This is a rather large black species whose mature larvae are somewhat larger than the *Diadasia* larva. The authors have observed oviposition in more than twenty species of *Lytta*, including close relatives of *L. melaena*. For this reason it is probably safe to assume that *melaena* follows the normal pattern of preparing a short burrow in the soil to a depth of two to three inches and laying several hundred eggs at the end of the burrow. The incubation period for the eggs of other members of the genus is about two weeks, after which the first instar larvae crawl over the surface searching out new cell series of their host. Although the authors previously (1942) presumed that larvae of *L. occipitalis* Horn contacted the host bees by climbing surrounding vegetation, they now appreciate that this assumption was erroneous. The feeding habit of this genus is apparently that of a specialized predator which consumes the contents of one or more cells regardless of their nature. After the first four feeding instars the larva burrows several inches away from the cell series and constructs a resting chamber. This activity appears to effectively protect the

meloid from parasitism by other members of the community. Of the 15 specimens collected only the four listed as pupae in Table I transformed during the season in which they were collected. The 11 larvae have not yet transformed as of June, 1952. We have previously observed this habit in meloids which attack bees and apparently it is a mechanism to carry the species over unfavorable seasons.

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THE HABITAT OF TWO RARE CALIFORNIAN HISTERIDAE

(Coleoptera)

Onthophilus lecontei Horn, 1870, and *Margarinotus remotus* (Leconte), 1859, are among the rarest of Californian Histeridae. As is often the case in rare insects, the rarity is due apparently to the restriction of these species to a special ecological niche seldom investigated by collectors. Dr. F. X. Williams has recently presented the California Academy of Sciences with a series of 14 specimens of *O. lecontei* and 13 of *M. remotus* collected in company with numerous individuals of the common *Saprinus paeminosus* Leconte in the nest chamber and burrows of *Thomomys bottae bottae* Eydoux & Gervais (Botta pocket gopher) at Danville, Contra Costa Co., Calif., February 9, through April 17, 1952.

This is strong evidence that such burrows constitute the normal habitat of these two species. With one exception (a specimen of *lecontei* collected in a gopher burrow at Atascadero, Calif.) all other known specimens have been collected as stragglers during the rare periods when the species ranged out of their normal habitat.—EDWARD S. ROSS, *California Academy of Sciences.*

DESCRIPTION OF A NEW SPECIES OF *AEGUS* FROM THE SOLOMON ISLANDS, WITH REMARKS ON OTHER STAGBEETLES

(Coleoptera: Lucanidae)

BERNARD BENESH
Burrville, Tennessee

The present paper contains the description of a new species of *Aegus* from the Solomon Islands, a characterization of *Ceratognathus tasmanus* Benesh and *C. westwoodi Thomson*, and a rectification of an error made by the writer in an earlier paper.

Aegus pulverosus Benesh, new species

This new species is sufficiently distinct that a cursory diagnosis will suffice for identification of the insect. Obovate, strongly convex; of olive-gray aspect, the dorsum being covered with very dense, abbreviated pile (giving the insect a pulverous appearance), intermixed with pronounced reddish-brown tufts.

Female—Head transverse, anterior margin straight, angles rounded; sides diverging posteriorly and feebly arcuate to opposite the eyes; head cribripunctate, each puncture bearing a tuft of redish-brown pile. Eyes large, parallel. Canthus slightly emarginate anterior to the eye and half-way circumscribing the eyes; postocular section converging to occiput. Mandibles shorter than head, laterally keeled, arcuate, apices acute; inner margin of right mandible with a bifid tooth, that of the left with a single, simple tooth; punctured on top and pulverose, apices and inner margins glabrous, black. Antennae stout, ferrugineous, the three terminal segments forming the clava, which is pubescent. *Pronotum* broader than long, anterior margin nearly straight, anterior angles produced and subacute; sides arcuate to lateral angles, which are obtuse, thence semicircularly excised and converging to base, basal angles obtuse, the base broadly arcuate; tufted irregularly throughout with brownish pile, without apparent punctuation. Scutellum invisible, squamose. Elytra broader than long, humeri rounded, sides arcuate, posterior margins rounded; pulverose throughout, with four, broadly spaced lines of brownish tufts, with alternate tufts between. *Legs* fairly stout and short, punctate throughout, pulverose and linearly tufted; anterior tibiae furcate, with three external spines; intermediate and posterior tibiae with one feeble spine at apical third. *Venter* ferrugineous; pro-, meso- and metasternum, inflexed portion of the elytra, and first ventral sternite shining, cribripunctate, the interior of punctures squamose; last four sterna impunctate, pulverose, and tufted. Mentum slightly broader than long, anteriorly and laterally rounded, base straight.

Male unknown.

Measurements (in millimeters):	Length	Width
Head	1.1	3.0
Pronotum	2.6	4.5
Elytra	4.1	4.7

Holotype: A female from PIVA RIVER, BOUGAINVILLE, SOLOMON ISLANDS, collected by B. D. Valentine in October, 1944. Deposited in the collection of B. Benesh at Chicago Natural History Museum.

CERATOGNATHUS TASMANUS Benesh and C. WESTWOODI Thomson

I have been asked to elucidate the specific differences between *C. tasmanus* and *westwoodi*, in order to facilitate identification of the two species. I do so herewith, utilizing the description of the first and comparing it with a specimen[1] in my collection, that is definitely determined as *westwoodi*. Incidentally, a specimen that had been received from the Australian Museum under the specific name *westwoodi* (identified by Mr. Oke), proved to be *C. flabellatus* Boileau, a desideratum of long standing. The differences between the two species can be tabulated as follows:

westwoodi	*tasmanus*
Mandibles slender, arcuate, inner margins laminate and serratulate.	Mandibles at middle angulate, apices bifid, with two obtuse, distant teeth on top, one on the angulation, the other posterior to the apical fork.
Anterior margin of head produced at middle into a blunt point.	Anterior margin nearly straight, simple. Eyes larger.
Sides of pronotum nearly uniformly arcuate from anterior to basal angles.	Pronotal sides diagonally arcuate to middle, thence parallel to basal angles.
Scutellum longer than broad, uniformly cribripunctate.	Scutellum broader than long; punctation circumscribed by an impressed line.
Elytra noncostate.	Elytra with a sutural and two lateral costae.

PLATYCERUS CRIBRIPENNIS Van Dyke

This species, described by Dr. Van Dyke as a variety of *P. piceus* Kirby (= *depressus* LeConte), was declared by me to be just a mutant of *P. marginalis* Casey. This opinion was based upon examination of a specimen whose owner asserted that it had been compared with the type and pronounced a good match[2].

On a recent visit to the California Academy of Sciences I was able, through the kindness of Dr. Van Dyke, to examine the typical specimens and I found them to be distinctive. However, I do not

[1]Taken by the Harvard Australia Expedition on Mt. Kosciusko, New South Wales, 5-7,000 ft., Dec. 12, 1931.

[2]Trans. Amer. Ent. Soc. LXXII, p. 173, 1946 (footnote).

consider the insects to be variants of *P. piceus;* I believe that they represent a separate species. *P. cribripennis* differs from *P. piceus* in the conformation of the mandibles, the cribriform sculpture of the pronotum, the more clear cut sculpture (with the walls of the punctures more straight, not sloping as in *P. marginalis*, and in its anthracite black color and higher luster. Specimens of *P. piceus* generally have only the head and pronotum feebly shining and the elytra are more or less opaque.

I take pleasure in rectifying my error, and thank Dr. Van Dyke for having made it possible for me to do so. I also wish to thank Mr. Rupert L. Wenzel, Chicago Natural History Museum, for reading and correcting this manuscript and for valuable suggestions.

TWO PALAEARCTIC ORTHOPTERA ESTABLISHED IN THE UNITED STATES

(Mantidae, Tettigoniidae)

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In a lot of several thousand western Orthoptera sent to me for identification from the University of California I found specimens of *Phaneroptera quadripunctata* Brunner and a species of *Iris*. Being unable to arrive at a confident determination of the *Iris* I sent specimens to Dr. B. P. Uvarov of the British Anti-Locust Centre, who has made extensive study of the genus. He informs me that the mantis is *Iris oratoria* (L.) and also reassures me on the identification of the *Phaneroptera*. Specific records are:

IRIS ORATORIA (LINNAEUS)

Brawley, Calif., VII-11-1950, at light, 3 ♂ (K. W. Tucker); Imperial Valley, Calif., 1950, 2 ♂; Shafter, Calif., IX-6-48, 1 ♀ (R. V. C. Bosch) Sanger, Fresno County, X-14-50, 1 ♂ (O. G. Bacon); Palm Springs, VI-11-1940, 2 immature specimens (N. Reynolds); Palms to Pine Highway, 1000, V-24-1940, 1 immature (F. H. Rindge); Cathedral City, VIII-14-50, 1 ♂ (L. W. Isaak); Beaumont, VII-4-47, 1 ♀.

This mantis can be distinguished at once by the two tubercles on the frontal disc and the small spines at the tip of the middle and hind femora. Superficially it resembles a species of *Stagmomantis*.

PHANEROPTERA QUADRIPUNCTATA BRUNNER

Mountain View, Calif., Sept. 9 - Nov. 29, 1941, 4 ♂ and 1 ♀ (Kenneth Frick); IX-13-43, 1 ♀ (K. Frick); Niles, Calif., IX-16-32, 1 ♂.

NOTES ON COCCINELLIDS IN THE PACIFIC NORTHWEST

(Coleoptera)

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The effectiveness of coccinellids, or lady beetles, in the control of aphids is sometimes underestimated by economic entomologists, probably because it is customary to take note of them only in times of aphid outbreaks. Lady beetles, as well as other natural enemies of the aphids except fungus disease, may be inadequate for control at times when aphids have been given an unusual advantage by weather conditions. It would be better to think of these predaceous insects as ever present and helping to keep down aphid populations every year. Aphid outbreaks would probably be a yearly occurrence without them. As lady beetles are very susceptible to some insecticides, it would be well to consider the possible effect on their numbers of the chemical treatment of large areas.

On the other hand, some people believe that the importation of large numbers of lady beetles into their fields or orchards would be a cheap and easy means of controlling aphids on their property. Their confidence in the effectiveness of these predators has led them to invest in stocks of lady beetles that have been collected in distant areas. Davidson (1924), in California, demonstrated that this practice cannot be of value to the individual grower, because the imported beetles disperse widely after release. This rapid dispersal of imported beetles has also been noted by Packard and Campbell (1926) in the Antelope Valley of southern California, Knowlton *et al.* (1938) in Utah, Eddy (1939) in Louisiana, Garman (1936) in Connecticut, and Hedrick (1934) in New York. Whether or not the region would benefit if large numbers of lady bettles were brought into it would be very difficult to demonstrate.

The habit of some species of coccinellids of collecting in masses in certain restricted locations at certain times has rendered

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[1]Retired October 31, 1948. In addition to my own notes I have assembled and compiled the notes of several coworkers of the Bureau of Entomology and Plant Quarantine who were located at Forest Grove, Oregon, but I alone am responsible for this arrangement and the conclusions drawn. Among these coworkers were Mrs. S. K. Zimmerman (nee Keen), A. C. Burrill, Max M. Reeher, and T. R. Chamberlin.

their collection for exploitation comparatively easy. The tendency of these species is to return to the same sites year after year, even though the returning beetles themselves have had no previous association with that site. In the West such aggregations have been called lady beetle caches. These caches are susceptible to serious damage by fire at the hands of the ignorant or careless.

Caches, or masses, of lady beetles are much more common than is generally supposed, at least in the West. A. C. Burrill, with the help of employees of the United States Forest Service and others, accumulated reports of lady beetle caches during the period 1918 to 1920. By adding to these reports the definite records made by other workers, we have records of about 25 such caches scattered over the region west of the Cascade Mountains and east of the Coast Range divide, and about 45 in Oregon and Washington east of the Cascade Mountains. Doubtless there are many other cache sites in both regions which have never been reported, as these caches are not easy to discover except at certain opportune times. Similar caches in California were known, and beetle collections were made from some of them for many years (Carnes, 1912). They have also been reported in Nevada (Nunenmacher, 1910), in Utah (Knowlton *et al.* 1938), in Colorado (Gillette, 1923), in New Mexico (Douglass, 1930), in Michigan and in the southeastern United States (Sherman, 1938).

In the Pacific Northwest west of the Cascade Mountains, three species of *Hippodamia* are found in these caches—*quinquesignata* (Kirby), mostly of the spotless or nearly spotless form *ambigua*[2], *sinuata* Mulsant, mostly of the form *spuria* LeConte[2], and *convergens* Guérin-Méneville[2]. Caches of *quinquesignata* and *sinuata* occur in the same localities, on bald, dry hill tops, the highest in the region, such as Bald Peak in the Chehalem Hills about 10 miles south of Forest Grove (discovered by Miss Keen on April 29, 1922), and Peterson's Butte near Lebanon in Linn County (discovered by entomologists from Oregon State College in 1918). Although the caches of these two species occur together, they are not much intermingled, each species tending to bunch up with its own kind, *quinquesignata* usually a little higher up the slope than *sinuata*. They occur well down in the crowns of a bunch grass, fescue, or around wild rose bushes, blackberry vines, and poison

[2]Determinations were made by P. H. Timberlake in 1920.

oak (mostly *sinuata* in blackberry vines and poison oak) on southwest-facing slopes. Such caches are not easily discovered except when the beetles are assembling in September and October, when basking in the sun on sunny days in early spring, or when leaving in March or April. When the beetles in the bunch grass are disturbed, they "boil up" in large numbers from each grass crown, except in cold weather when they are torpid. *H. sinuata* are usually more numerous than *quinquesignata* in these caches. The mating, or attempted mating, of male *sinuata* with female *quinquesignata* is frequently observed when the beetles are leaving the cache. Pale red *sinuata spuria*[2] with greatly reduced spots, sometimes altogether spotless, have been found in some numbers in the Bald Peak cache and also in the cache on Peterson's Butte. Typical *qinquesignata* are a brilliant red, whereas the red of *sinuata* is usually much faded, sometimes nearly to yellow.

Cache sites of *Hippodamia convergens* in western Oregon are quite different—usually near water, on stumps, bracken, bushes and small trees in cold damp canyons, such as Clear Creek Canyon six miles northwest of Forest Grove, or on rushes in swampy spots —and the exposure in general is eastern. In a small swampy spot near the Forest Grove reservoir, on October 20, 1926, the beetles were in clumps at the tops of the rushes, giving the impression of exotic bloom. In February 1935, T. R. Chamberlin found a small cache of mostly spotless *convergens* on rushes in a marshy spot on the valley level at the foot of a slight east-facing slope near Rickreall in Polk County. Specimens taken here so closely resembled the spotless form of *quinquesignata* that we were not sure of the species until mounts of the male genitalia proved to agree with Timberlake's (1919) description of *convergens.* Ewing (1913) reported masses of lady beetles on the summit of Mt. Chintimini (now called Mary's Peak), the highest point in the Coast Range of Oregon. He stated that some of the beetles he found cached there were *spuria* LeConte and that others were *convergens* Guérin-Méneville.

The late R. C. Treherne wrote (Nov. 5, 1921) that the lady beetle caches in British Columbia "that face the west are, I believe, *H. 5-signata,* whereas the one facing the east is probably *H. convergens.*" This idea had not occurred to us, but our observations on the sites that we have seen confirm Treherne's tentative theory. It would be desirable for someone to make a study of this interest-

ing phenomenon of massing by lady beetles, if he were careful to make accurate determinations. The determination of the species of this genus is very difficult, and the male genitalia must be studied to verify them (Timberlake, 1919, and Chapin, 1946).

Most of the caches that have been reported in the area east of the Cascade Mountains are presumably of *Hippodamia convergens*, but we have seen few specimens from such caches. A form of *caseyi* Johnson that is spotted like *convergens* was noted in numbers near Wenatchee, Washington (Timberlake, 1919). Caches are known to occur on the isolated buttes of the Palouse region as well as in the Blue Mountains. In Okanogan County, Washington, many of the caches, judging from specimens collected by A. C. Burrill in 1918 and 1919, are of *caseyi* Johnson[2]. Knowlton *et al.* (1938) recorded the finding of caches of *quinquesignata* in Utah.

No one knows from how far the beetles come to these caches. We have observed that *Hippodamia sinuata* and *quinquesignata* are not present in the fields near Forest Grove until the beetles have begun to leave the caches on Bald Peak, 10 miles away. It is quite possible that the beetles travel long distances to reach some of the caches, particularly those in the high mountains. The beetles usually come to the caches on Bald Peak in September and October, but in 1931, some were observed in the grass crowns as early as July 16. In that year previously large populations of pea aphids on annual legumes were very greatly reduced in May or in early June. On July 4, 1926, after a similar sequence of pea aphid populations, a picnic party observed *convergens* massing in Clear Creek Canyon. Sherman (1938) has suggested that hibernation does not seem to be the primary reason for massing in the mountains of the Southeastern States. It seems possible that a sudden failure of the food supply might lead some of the beetles to go to the caches earlier than usual. Such sites may afford better chances for survival without food and with a minimum of activity than do fields at lower levels or in warmer situations. The beetles usually leave the caches in western Oregon in April, but sometimes as early as February or March. *H. convergens* appears to leave its caches a few days earlier than do *sinuata* and *quinquesignata*. In any case the beetles leave on days when temperatures are sufficiently high to permit normal activity. Hence the value of introducing them into the fields before that time would be questionable.

Observations on the caches on Bald Peak were made by us in

the fall and spring of each year in the period 1922 to 1942, except in the years 1925, 1928, and 1929. The numbers of the beetles in these caches varied greatly from year to year. The beetles occurred in enormous numbers following a year of great abundance of the pea aphid, *Macrosiphum pisi* (Kalt.), on the field crops, and, conversely, the caches were usually sparsely populated and the area occupied by them greatly reduced when the previous season had been one in which the pea aphid was not abundant in the fields of the surrounding area. In some years there is a considerable mortality among the beetles in the caches and the entomogenous fungus *Beauveria bassiana* (Balsamo) Vuillemin develops on many of them.

That coccinellid larvae and adults are voracious feeders on aphids has been demonstrated by feeding records published by Palmer (1914), Clausen (1915, 1916), Cutright (1924), and Stehr (1930). Such records are not comparable because of differences in the species of aphids fed and the physical conditions under which the experiments were carried on. In 1921 Miss Keen carried on similar experiments at Forest Grove with several species of coccinellids, using *Macrosiphum pisi* as food, at unheated room temperatures (rarely exceeding 70°F.) in May and June for the adults and in July for the larvae. Her findings are abstracted as follows:

Hippodamia sinuata: 5 larvae ate a mean of 306±44 aphids each in a larval period of 21 days (3)[3] and 33 to 35 days (2), the most eaten in 1 day by 1 larva being 28. Five adults ate a mean of 380±11 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 21. The average life of the adult beetles in cages was 83 days after collection.

H. quinquesignata: 6 larvae ate a mean of 245±39 aphids each in a larval period of 11 days (2), 17 to 19 days (3) and 33 days (1), the most eaten in 1 day by 1 larva being 30. Four adults ate a mean of 336±8 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 18. The average life of the beetles in cages was 73 days after collection. It should be noted that variations in the length of the larval period, and consequently in the number of aphids eaten, were considerable in the case of this species and also in that of *H. sinuata.*

[3]Figures in parentheses indicate the number of specimens reared.

H. convergens: 4 larvae ate a mean of 207±7 aphids each in a larval period of 22 to 23 days, the most eaten by 1 larva in 1 day being 27. Two adults ate an average of 308 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 20. The average life of the adult beetles in cages was 67 days after collection.

H. tredecimpunctata tibialis (Say)[4]: 3 larvae ate a mean of 198±2 aphids each in a larval period of 26 to 27 days, the most eaten by 1 larva in 1 day being 15. One adult ate 342 aphids in 31 days, the most eaten in 1 day being 18. This adult lived 59 days after collection.

H. lunatomaculata Motschulsky[2]: 4 larvae ate a mean of 224±9 aphids each in a larval period of 22 to 25 days, the most eaten in 1 day by 1 larva being 21. Four adults ate a mean of 302±7 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 14. The beetles lived an average of 67 days after collection.

Coccinella trifasciata Linnaeus[4]: 2 larvae ate an average of 175 aphids each in a larval period of 27 days, the most eaten by 1 larva in 1 day being 15. Three adults ate a mean of 295±9 aphids each in 31 days, the most eaten by 1 beetle in 1 day being 19. The beetles lived an average of 85 days after collection.

Cycloneda polita Casey[2]: 2 larvae ate an average of 148 aphids each in a larval period of 17 to 19 days, the most eaten by 1 larva in 1 day being 15. Four adults ate a mean of 344±12 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 14. The beetles lived an average of 48 days after collection.

These experiments demonstrated that the three species of *Hippodamia* that are known to have the habit of massing in caches, namely *sinuata*, *quinquesignata*, and *convergens*, are important predators on aphids in this area. In these counts *convergens* ate fewer aphids than the others.

In the Willamette Valley all these species are common on vetch and alfalfa, and on Austrian winter field peas infested by the pea aphid. Vetch, whether infested by aphids or not, attracts large numbers of coccinellid beetles, as Ewing (1913) has also noted. This is probably because the beetles often feed at the nectaries on the stipules. The same is true for alfalfa. Lady beetles do not appear to be attracted to peas unless aphids are abundant, and it has been our experience that syrphid larvae, often hatched from

[4]Determined by M. C. Lane.

eggs laid on the plant tips in anticipation of aphid infestation, are usually better predators on that host plant than are lady beetles. *Hippodamia lunatomaculata* was noted in abundance only on red clover when the host plants were heavily infested by the clover head aphid, *Anuraphis bakeri* (Cowan). *H. quinquesignata* usually outnumbered other *Hippodamia* on vetch. *H. sinuata* was abundant on alfalfa on April 27, 1933, and on corn in September 1931. *H. tibialis* were not found in large numbers on any of the field crops. *Coccinella trifasciata* was sometimes more abundant than *Hippodamia* on vetch and alfalfa. *Cycloneda polita* was commonly found on vetch and alfalfa. In some years *Adalia bipunctata* (Linnaeus) became abundant on aphid-infested Austrian peas and vetch in some fields. *Coccinella transverso-guttata* Fald. was much more abundant, on alfalfa, east of the Cascade Mountains than in western Oregon. *Hippodamia apicalis* Casey[2] was also a very common species on alfalfa in eastern Washington and eastern Oregon.

In 1941 and 1942 a rotary trap[5] was operated at Forest Grove by J. C. Chamberlin, of this Bureau, and I was permitted to examine the catch for coccinellids. In 1941 *Hippodamia convergens* was caught as early as February 19 and 20 at 60°F.; *Adalia bipunctata* on March 6, at 62°, and the first *H. quinquesignata* and *Coccinella trifasciata* on March 7 at 66°. The total catch in 1941, February 18 to May 15, was as follows: *Hippodamia quinquesignata* 694 (possibly some spotless forms of *H. convergens* were included in this count), *Adalia bipunctata* 521, *H. convergens* 477, *Coccinella trifasciata* 347, *Cycloneda polita* 273, *H. sinuata* 173, *H. lunatomaculata* 4, and *Coccinella transversoguttata* 2. As many as 143 *H. quinquesignata*, 113 *H. convergens*, 61 *Cycloneda polita*, and 60 *Coccinella trifasciata* were caught in one 24-hour period on warm days in April and May. The preceding year had been one of pea aphid abundance. The total catch in 1942, April 19 to June 5, was as follows: *Cocinella trifasciata* 185, *Hippodamia sinuata* 129, *H. quinquesignata* 125, *Cycloneda polita* 93, *Adalia bipunctata* 48, *H. convergens* 14. The trap was not set out early enough to get the first movement of coccinellid beetles and it was located in a different place from that in 1941, but the drop in numbers in April and May was striking as compared with 1941.

The conclusions are that coccinellid beetles are worthy of pro-

[5]For description of trap see U. S. Bur. Ent. and Plant Quar. ET-163, 6 pp. (1940) (Processed.) and Mosquito News, 5 (1): 8-16; illus. (1945).

tection, not only from the ignorant or careless but also from well-meaning exploiters of the massing habit of some species, especially as the exploiters may be "robbing Peter to pay Paul." The caches of these lady beetles are valuable natural assets and should be conserved as such. They are more common and widely distributed than is generally known, and no one knows whence the beetles come to them nor whither they go. The caches are vulnerable to fire and some insecticides.

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TRYPANOSOMA CRUZI REVEALED IN CALIFORNIA MICE BY XENODIAGNOSIS

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INTRODUCTION

Brumpt[1] introduced the term xenodiagnosis for a method of detecting trypanosomes in mammal hosts by feeding laboratory-bred reduviid bugs upon the animal. While studying the blood parasites of mammals at the San Joaquin Experimental Range near O'Neals, California, the writer exposed 186 captured mammals to 670 feedings by 612 cone-nosed bugs. The majority of these insects were 1st instar nymphs of the species of *Triatoma* used and 3rd and 4th instar nymphs for the *Paratriatoma*. All bugs were laboratory raised or examined prior to feeding so were known to be free of trypanosomes. The largest number fed on any mammal

*The writer wishes to thank the California Forest and Range Experiment Station and the Division of Zoology at Davis, University of California for use of facilities at the San Joaquin Experimental Range, O'Neals, California; Dr. Fae D. Wood for her constructive criticisms of this manuscript; and Mr. Kenneth Stager of the Los Angeles County Museum for assistance in bat identifications.

was 18, the smallest number being 1 and the average for all mammals 3.6. Since the habits of these bugs affect their value in xenodiagnosis, some observations are recorded below concerning their usefulness in this process.

Observations

The captured mammals included 91 Chiroptera, 92 Rodentia and 3 Lagomorpha. Two Gilbert white footed mice, *Peromyscus truei gilberti* (Allen), were found to harbor *Trypanosoma cruzi* Chagas, the causative agent of Chagas' disease. Not only did blood smears reveal a trypanosome morphologically identical to *Trypanosoma cruzi*, but *Triatoma* fed upon the rodents subsequently revealed developmental forms of *Trypanosoma cruzi*.

One female *Peromyscus truei gilberti*, at time of capture, served to feed 6 laboratory-raised, unfed 1st instar nymphs of *Triatoma protracta*. All of these bugs showed metacyclic *Trypanosoma cruzi* in voluntary fecal samples 104 days after the original blood meal. The male mouse was host to 4 laboratory-raised, unfed 1st instar *Triatoma protracta* nymphs, of which 3 showed trypanosomes in their feces 95 days after feeding on the mouse.

Of the seven slides from the adult female *Peromyscus*, five were blood smears (6-VII-50) and two were thick drop preparations (7-VII-50). Three blood smears of 384, 250, and 299 sq. mm. were negative while 4 broken trypanosomes were seen in a 242 sq. mm. smear and one whole and two broken trypanosomes were found in a 320 sq. mm. smear. This parasite resembled in form the flattened trypanosome illustrated in Plate 2, Figure 31 of Wood[13]. However, the nucleus was rounded, the kinetoplast triangular, and the cytoplasm basophilic with 17 volutin granules. One thick drop slide revealed 5 trypanosomes, the other none. All 6 bugs fed on this mouse were positive as noted above. Two trypanosomes were seen in the fresh blood sample from the left ear under an 18 mm. circular coverglass but not recognized as *Trypanosoma cruzi* at the time.

A single 450 sq. mm. blood smear from the adult male *Peromyscus* was negative and no trypanosomes were seen in the fresh blood sample. Both animals were trapped near the headquarters area where many *Triatoma*, naturally infected with *Trypanosoma cruzi*, were found by Wood[15].

One 12 gram, male white mouse, *Mus musculus*, Experiment 141, was inoculated intramuscularly (right gastrocnemius) with a 0.1 ml. suspension in sodium citrate solution of 3 voluntary fecal samples from a 4th instar *protracta* nymph which had fed on the female *Peromyscus* at O'Neals. Trypanosomes were seen in the blood from the 9th to the 42nd day with the maximum number of 91 counted from two drops of tail blood under an 18 mm. circular coverglass on the 22nd day. Both living and stained trypanosomes were typical blood forms of *Trypanosoma cruzi* as illustrated in Plate 2, Figure 36 of Wood[13].

Of the 612 cone-nosed bugs, 322 (9 ♂, 15 ♀, 15 fifth, 10 fourth, 3 third, 5 second and 265 first instar nymphs) were *Triatoma protracta* (Uhler), 232 (4 ♂, 7 ♀, 1 fifth, 1 fourth, 2 second, and 217 first instar nymphs) were *Triatoma rubida uhleri* (Neiva), 49 (3 ♂, 4 ♀, 5 fifth, 16 fourth, 14 third, and 7 second instar nymphs) were *Paratriatoma hirsuta* Barber, and 9 (1st instar nymphs) were *Triatoma longipes* Barber. Six hundred twelve bugs were used for one xenodiagnostic feeding, 28 for one additional feeding on a new host and 15 for two additional feedings on new hosts. With those bugs used for the 2nd and 3rd xenodiagnostic feedings, the procedure followed was to feed the bug on the new host after a minimum of 14 days and examine the fresh fecal deposits immediately after each new feeding. The 43 bugs used again for xenodiagnosis of new hosts as well as most of the bugs fed on one host were negative for all feedings as reported above.

The three bugs, *Triatoma protracta*, *T. rubida uhleri* and *Paratriatoma hirsuta*, were under constant observation during the summer period. Usinger[5] reports respective body lengths as 18, 20 and 12 mm. for adults. From the standpoint of their efficiency for use in xenodiagnosis, *Triatoma rubida uhleri* proved to be the best insect. Some advantages favoring the use of this bug in xenodiagnosis are: rapid feeding on all types of mammals, especially bats and active small rodents; quick recovery from host movement disturbances; more resistance to body damage from handling with fingers or forceps; greater ease of handling with forceps because of longer legs; rapid utilization of the blood meal by adults; greater blood volume intake of all stages but especially 1st, 2nd, and 3rd instars; rapid defecation after engorgement; and greater viability of eggs. Some disadvantages of this bug are: irritation of the host by preliminary quick jabbing of the proboscis; large

blood volume intake of adults and 4th and 5th instar nymphs greatly weakening small rodents; and greater rapidity of motion making capture difficult.

Some advantages for using *Triatoma protracta* in xenodiagnosis are: less irritation to host mammal since contact is made without repeated jabbing of the proboscis; greater ease of handling because of less rapid locomotion; and rapid utilization of the blood meal by adults. Some disadvantages of using this bug are: slower recovery from host movement disturbances to feeding; larger blood volume intake of adults and 4th and 5th instar nymphs; and slower defecation after a complete blood meal.

The use of *Paratriatoma hirsuta* for xenodiagnosis has the following advantages: rapid feeding ability; lower blood volume intake in adults and nymphs; less irritation of host animal by quick jabbing of the proboscis; and longer interval between feedings for all nymphal instars. Some disadvantages are: difficulty in handling because of small size; rapidity of locomotion; and slowness in defecation after engorgement.

Discussion

Although many California mammals have been examined previously, very few xenodiagnoses have been carried out by Wood and Wood[16] and Wood[7]. F. D. Wood[6] was the first to demonstrate *Trypanosoma cruzi* in the San Diego wood rat, *Neotoma fuscipes macrotis*, by examination of centrifuged blood. She also experimentally infected the Gilbert white footed mouse which is reported here naturally infected with *Trypanosoma cruzi* for the first time. Thus, there are now two mammal hosts known for this trypanosome in California, *Neotoma fuscipes macrotis* and *Peromyscus truei gilberti*.

Dias[3] has reported a third mammal host, the Pacific pallid bat, *Antrozous pallidus pacificus* from Pinole, Contra Costa County. Wood[9] found an anterior nuclear bat trypanosome, *T. vespertilionis*, in blood smears from *Antrozous pallidus pacificus* in 1941. During the summer of 1950, xenodiagnosis of 76 *Antrozous pallidus pacificus*, of which 9 were found by blood examination (8 fresh, 1 dried) to harbor *Trypanosoma vespertilionis*, failed to reveal *Trypanosoma cruzi*. Because of *Triatoma's* nocturnal flight habits[12], and since both the bats and *Triatoma* were observed flying at night

it may be assumed that the bugs were available as food to the bats[15] In 1946, the writer fed *Triatoma* to *Antrozous pallidus pallidus* in captivity. Adults of both *Triatoma protracta* and *T. rubida uhleri* were chewed and in one instance a female *rubida uhleri* was eaten. Dead adults were rejected after preliminary chewing but live nymphs with and without *Trypanosoma cruzi* were eaten rapidly. Therefore, the trypanosome seen by Dias in 2 of 8 *Antrozous pallidus pacificus* was probably *Trypanosoma vespertilionis*. The conspicuously close proximity of the nucleus to the anterior border of the cytosome in this trypanosome distinguishes it from blood forms of *Trypanosoma cruzi*.

Environmental temperature has been shown by Kolodny[4] to influence laboratory infections of *Trypanosoma cruzi* in rats, producing milder infections (blood invasions) in summer (June 15th to September 15th) than fall, winter, or early spring. This might explain the low number of positive xenodiagnoses encountered here as compared with the much larger number found in Arizona during the winter, when 4 of 16 rodents revealed infection[11].

Brief mention of *Triatoma* feeding habits was made by Wood and Wood[17] for *protracta* and *rubida uhleri* and by Wood[8] for *rubida uhleri* and *longipes*. All adult bugs are quicker to metabolize their blood meal, thus can be used again at shorter intervals for new suspected hosts. The 1st instar nymphs, because of relatively small volume intake, can be used again at 14 day intervals if the environmental temperature is high enough. Since *Paratriatoma hirsuta* apparently metabolizes its blood meal at all stages more slowly than *T. protracta* or *T. rubida uhleri*, it can not be used at 14 day intervals. However, if sufficient *P. hirsuta* were available, the longer interval is advantageous in the summer, since the bugs need not be examined immediately or fed again for some time.

Even though *rubida uhleri* is faster moving at higher temperatures than *protracta* and about the same as *hirsuta*, the bug is easier to handle with either fingers or forceps because of its larger size and longer legs. *Triatoma rubida uhleri* is the easiest to hold with fingers for squeezing fecal samples and appears to survive rough treatment better than either *protracta* or *hirsuta*. Adult males of all species are difficult to squeeze and therefore should be reserved for voluntary samples since permanent injury usually follows the pressure treatment. Adult females can be squeezed successfully with less

possibility of permanent injury. Damage to reproductive and digestive organs may result from rough handling. Investigators working with *Triatoma* infected with virulent parasites should keep the face well away while squeezing any of these bugs for fecal examinations since at least one laboratory worker has been infected using this technique[2].

Usually it is advantageous to feed adults and large nymphs on rodents because the large blood sample may reveal light infections. If the animal is needed for further experimentation and is smaller than a white mouse, 20 bugs feeding to capacity at one time may kill the animal. Experimental animals can not tolerate many large bugs feeding on them at one time but can survive the feeding of many 1st instar nymphs as noted by the writer[10].

Other factors favoring the use of *Triatoma rubida uhleri* in xenodiagnosis are the large number of defecations shortly after engorgement and the shorter egg incubation period. The writer[14] has recently recorded data showing an average of 7 voluntary fecal deposits at 91° F. for *rubida uhleri* as against 3 deposits for *protracta* at 91° and 94° F. during the first hour after a full blood meal. Usinger[5] reports a 16–18 day incubation period for *rubida uhleri* reared under constant temperature and humidity.

Summary

Exposure of 186 captured mammals (91 Chiroptera, 92 Rodentia and 3 Lagomorpha) to 670 feedings of 612 cone-nosed bugs revealed two Gilbert white footed mice, *Peromyscus truei gilberti*, naturally infected with *Trypanosoma cruzi* Chagas. *Triatoma rubida uhleri* is more useful for xenodiagnosis than either *Triatoma protracta* or *Paratriatoma hirsuta*.

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A REVIEW OF THE GENUS *STOMATOTHRIPS* HOOD

(Thysanoptera: Aeolothripidae)

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This small genus of the order Thysanoptera, like most others in North America, is in need of being redescribed and brought up to date. In 1912 Hood described *Stomatothrips* and designated the only species known, *flavus* Hood, as the genotype. Since that time five additional species have been characterized which gives a much broader base on which to set apart this aeolothripid group.[1] Originally it was compared properly with *Orothrips* and *Erythrothrips* Moulton. However, among the species of *Stomatothrips* it is now apparent that the number of segments of the maxillary palpus varies somewhat, but less so than in *Erythrothrips* (Bailey, 1947). Therefore, it is no longer possible to clearly separate these genera (and all species therein) on the basis of this character alone (Bagnall, 1932, Watson, 1923). The genus now can be redescribed to include the characters the known species have in common.

It, no doubt, is presumptuous to attempt to prepare a taxonomic review of a group of insects without having seen any of the types! However, based on the study of five paratypes (three females and two males) of *flavus*, on 52 specimens of *brunneus* (det. Bailey) some of which have been compared with the unique type of *brunneus* by Miss Kellie O'Neill, and two specimens of *septenarius*, one from Trinidad (coll. C. B. Williams, March 29, 1915) and one from Honduras, it is now possible to establish several good reference points to aid present and future thysanopterists in identification and revisional work. In this genus, species are separated by the relative size of wings and antennae and the degree of coloration, which characters are not always constant. Such reliance on color variations particularly is most undesirable but is necessary in this genus until longer series of specimens are taken or the types made available and better anatomical characters discovered.

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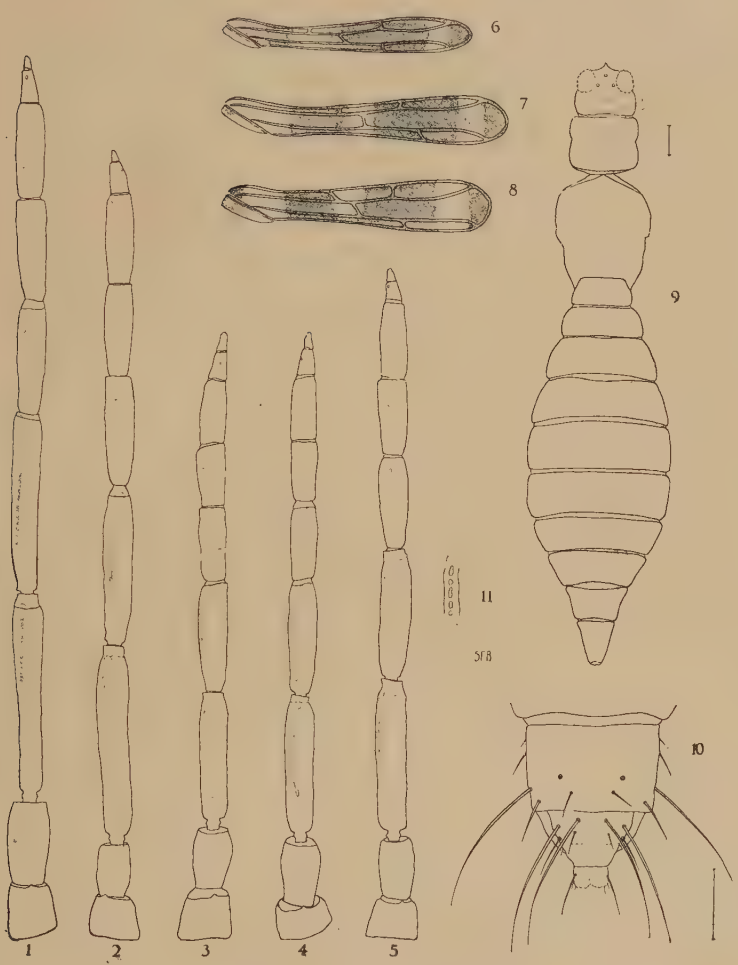
[1]This study is based on 119 specimens representing four species of this uncommon genus. The writer is indebted to Mr. C. F. W. Muesebeck and Miss Kellie O'Neill of the Division of Insect Identification, U.S D.A., Prof. A. N. Tissot, Univ. of Florida, Dr. C. B. Williams, Rothamsted Experiment Station, England, Dr. H. Priesner, Ministry of Agriculture, Cairo, Egypt, K. Sakimura, Honolulu, Dean Floyd Andre, Iowa State College, L. J. Stannard, Illinois Nat. Hist. Survey, and the Canadian National Museum, Ottawa, for loans and gifts of specimens.



EXPLANATION OF FIGURES

Fig. 1. Antenna of *Stomatothrips flavus* Hood, female. Fig. 2. Antenna of *Stomatothrips flavus* Hood, paratype male. Fig. 3. Antenna of *Stomatothrips brunneus* J. C. Cwfd., female. Fig. 4. Antenna of *Stomatothrips brunneus* J. C. Cwfd., male. Fig. 5. Antenna of *Stomatothrips septenarius* Hood, female. Fig. 6. Forewing of *Stomatothrips septenarius* Hood. Fig. 7. Forewing of *Stomatothrips flavus* Hood, female. Fig. 8. Forewing of *Stomatothrips brunneus* J. C. Cwfd., female. Fig. 9. Body outline of *Stomatothrips flavus* Hood, female. Fig. 10. Terminal abdominal segments of *Stomatothrips flavus* Hood, male (dorsal). Fig. 11. Enlarged section of sensory area (not to scale). Scale: Figs. 1, 2, 3, 4, 5, line equals 0.01 mm.; Figs. 6, 7, 8, 9, line equals 0.10 mm.; Fig. 10 line equals 0.10 mm.

In comparison with other related genera, *Stomatothrips* is rather rare in collections. On the other hand, the distribution of the species in North America is much greater than *Ankothrips*, *Orothrips*, or *Erythrothrips*. At present, *Stomatothrips flavus* is known to occur from Arizona to Georgia and from North Dakota to Mexico, *brunneus* is restricted to the southwest, and *atratus* is known only from Texas. The remaining species are tropical.

Practically nothing is known of the biology of this group but they are undoubtedly predaceous. The wide variety of hosts from which they have been collected such as cotton, peach, grass, alfalfa, grape, yucca, and so on, indicates strongly this type of habit. The collection of several specimens from peach orchard soil (Crawford, 1940) by federal entomologists clearly indicates that pupation takes place in the ground. To our knowledge, larvae of *Stomatothrips* have not been identified. Based on our studies of related genera, we can conclude that the mature larva drops to the soil (or cover) beneath the hosts and forms a loose cocoon. Like *Franklinothrips*, this group of thrips is not sufficiently abundant in North America to be of any value in controlling injurious insects and mites.

Stomatothrips Hood, 1912

Head about as wide as long, not noticeably projected beyond eyes, broadly attached to thorax as in *Franklinothrips*. Compound eyes not produced or only slightly prolonged ventrally. Antennae nine-segmented, the distal segment very small and closely attached to the eighth, long and slender and somewhat differently proportioned in the sexes, similar in general appearance to *Erythrothrips* and not as thread-like as in *Franklinothrips*. Sensory areas on the antennal segments as follows: On III, narrow, linear and ventral, with central row of dots; on IV, narrow, ventral and hooked at tip on underside, curving inward (as in *Desmothrips)*, also with central row of dots; on V and VI, cuneiform; on VII, variable, linear to oval. Maxillary palpi geniculate, 7 to 8 segmented, sometimes fused near tip. Labial palpi five-segmented. Pronotum without strong spines. Fore tarsus with hook-like appendage. Wings distinctly expanded at tip and narrowed in second eighth (as in *Allelothrips* Bagnall) with two white cross bands, one sub-apical and the other in basal fourth. Two longitudinal veins in fore wing, with the usual cross-veins. Abdomen broadly expanded at segments IV to VII, with a narrow "waist" and sharply pointed at tip, as in *Franklinothrips*. Ovipositor upturned. Male small and slender without genital claspers, as in *Erythrothrips*. First abdominal segment elongate and divided into thirds by longitudinal ridges as in related genera. Antennal segments differently proportioned, segment VII usually longer than in female.

Genotype—*Stomatothrips flavus* Hood, 1912. By original designation. See also Priesner, 1949, p. 149.

STOMATOTHRIPS ANGUSTIPENNIS HOOD, 1949

1949. HOOD, J. D. Rev. de Ent. 20(1-3):12-14, fig. 9.

This species is known only from the original Brazilian material. It should be noted that this species has a micropterous form. The 7-segmented maxillary palps, the longer head, and the light-colored antennal segment IV separate it from related species.

STOMATOTHRIPS ATRATUS HOOD, 1939

1939. HOOD, J. D. Rev. de Ent. 10(3):550-551.

1949. BAILEY, S. F. Fla. Ent. 32(1):24.

This species was described from two females taken on a host thought to be *Lycium berlandieri* at San Antonio, Texas, March 22, 1939. There have been no published records of it since.

Male. Body dark brown. Legs concolorous with body. Wings marked as in original description of female, i.e., no pale spot in center of dark band. Antennal segments I and II dark brown; III yellowish brown, darker at tip, remaining segments dark brown, IV with light ring just above base. Sensory areas on antennae normal. Genitalia without claspers. Maxillary palpi seven-segmented, the terminal segments considerably shortened and indicating fusion. Setae on dorsum of head and pronotum small, scattered, and similar in size.

Described from one specimen from Winter Haven, Texas, taken by K. Sakimura (Collection 3507), October 3, 1948, ex. *Lycium berlandieri*. The slide is in the writer's collection.

STOMATOTHRIPS BRUNNEUS J. C. CRAWFORD, 1940

1940. CRAWFORD, J. C. Proc. Ent. Soc. Wash. 42(2):45.

1948. BAILEY, S. F. Fla. Ent. 31(2): 39, 41.

Female. Dark brown, often with red sub-hypodermal pigment rarely extending into legs, wings and antennae. Abdomen with segment II and X light brown. Legs dark brown with middle and hind femur usually lighter than tibiae.

Head wider than long, faintly striated, cheeks not strongly arched. Eyes not protruding and only slightly prolonged ventrally, post-ocular setae scattered, not strong, the largest being directly behind the posterior ocellus (and these are variable). Maxillary palpi 8-segmented. Antennal segments I and II brown, II yellowish brown distally, III yellow, usually with a circle of brown at tip, IV brown at tip with various degrees of shading to yellow base, V-IX dark brown. Sensory areas: on III linear, slightly curved at tip and extending over half the length of segment, IV recurved at tip, partly encircling the segment and extending two-thirds its length, on V and VI cuneiform and near distal end, on VII and VIII small and oval (see fig. 3).

Forewing very similar to that of *flavus* but usually slightly larger (see fig. 8). Fore vein with 18 to 25 setae, hind vein with 14 to 20, cross bands as in *flavus*. Hind wing faintly pigmented with grey in a similar pattern to that of forewing.

Legs brown, in dark specimens uniformly so but in teneral specimens with the femora mottled or yellow. The usual claw present on fore tarsi. Scattered small setae on entire surface of pronotum, two slightly stronger bristles near center of posterior margin. Shape of body as in fig. 9.

Measurments (in mm.): Head, length, .162, width, .216; antennal segments, I, .038; II, .051; III, .124; IV, .076; V, .060; VI, .048; VII, .048; VIII, .022; IX, .012. Pronotum: length, .202; width, .229. Forewing: length, .91; width at narrowest portion, .094, at widest portion .22 or 2.3 times width at narrowest point. Total body length, 1.97 (expanded).

Redescribed from a series of specimens from Texas, Iowa, Arizona, New Mexico, and Oklahoma. The above description takes into account color variations and the measurements are average figures for 25 specimens. Some individual specimens have very short antennae but vary in no other way.

Male. Color as in female. Abdomen slender and having the general appearance of an *Erythrothrips*. Genitalia without claspers as in *flavus* (see fig. 10). Antennae long and slender, bicolorous, segments I and II yellowish brown, II yellow at tip, III yellowish brown, IV-IX brown. Sensory areas as in *flavus* (see fig. 4.). Wings smaller and more slender.

Measurements (in mm.): Antennal segments, length, I, .032; II, .044; III, .115; IV, .089; V, .060; VI, .048; VII, .041; VIII, .016; IX, .011. Head: length, .155. Pronotum: length, .162. Forewing: length, .75; width at narrowest portion, .067; at widest portion, .112. Total body length, 1.5.

The male is described from a specimen with the following data: "Cover sweeping. Phoenix, Ariz., July 9, 1937. L. D. Christenson. C-25-58. Lot 37.25836." The slide is the property of the Federal Bureau of Entomology and Plant Quarantine, Washington, D.C.

This species appears to be more variable than any other studied. In the future *brunneus* will probably be found to be more than one species.

Stomatothrips flavus Hood, 1912

1912. Hood, J. D. Proc. Biol. Soc. Wash. 25:63-66, fig. 1.
1923. Watson, J. R. Univ. Fla. Agr. Exp. Sta. Bull. 168:8, 25.
1949. Bailey, S. F. Fla. Ent. 32(1):24.

The genotype may have been based upon what we now consider two species, *flavus* and *brunneus*. Of the five paratypes we have examined, two (one male and one female) have the shorter antennae, stronger post-ocellar setae, and somewhat larger wings which characterize *brunneus*. An examination of the holotype will be necessary to clearly establish the possible synonymy of *brunneus* and, if such is the case, a new name for the form with the long antennae which we have previously known as typical "*flavus*" will be necessary. Eventually, when a large series of specimens has been accumu-

lated throughout its range, a new species, intermediate between *flavus* and *brunneus*, may be justified.

It is desirable to supplement the original description with several characters which are now necessary to be known in order to key out the species.

The setae on the dorsum of the head are all about the same size, scattered and without a definite pattern. Eyes not prominent but slightly prolonged posteriorly. Sensory area on antennal segment III linear, variable in length, ventral, usually extending more than half the length of segment, expanded at tip and with minute, irregular, clear, circular areas in central portion (see figs. 1 and 11); a similar area on segment IV but curved at tip, and extending about three-fourths the length of the segment. One or two small, oval sensory areas on VII from which arise a cone. Segment IV yellow, usually with a very narrow brown ring at tip. Ovipositor upcurved. Male with dark greyish brown antenna (fig. 2) with the segments differently proportioned. Genitalia similar to *Erythrothrips*, without claspers (see fig. 10).

A micropterous form is now known from Illinois. It varies from the typical individuals only in the size of the wings which are 0.67–0.74 mm. long.

STOMATOTHRIPS SEPTENARIUS HOOD, 1925

1925. HOOD, J. D. Psyche 32(1):48-49.
1949. BAILEY, S. F. Fla. Ent. 32(1):24.

The single female specimen kindly made available by Dr. C. B. Williams, the collector, has the following data appended: "Trinidad, B.W.I., March 29, 1915. St. Joseph. No. 621. Swept from grass." The forewing and antenna have been illustrated for convenience (figs. 5 and 6) and the original description supplemented as follows:

Head brown, anterior portion yellowish brown. Ocelli with crimson crescents of pigment normal. Eyes not prominent, very slightly prolonged ventrally. Inter-ocular and post-ocular setae very moderate and without a characteristic pattern. Cheeks slightly swollen, with very faint reticulation. Maxillary palpi 7-segmented. Antennal segments I and II yellowish brown, III pale yellow to white with dark brown ring of pigment at tip, IV-IX dark brown, IV lighter in basal portion. Sensory areas as in *flavus* with that on segment IV strongly curved at tip (see fig. 5).

Forewing smoky brown with two white cross-bands, one in basal fourth and one in distal fourth, with an indistinct lighter area near center. The ring

vein is pigmented throughout its distal portion (see fig. 6). Fore veins of forewing with 19 and 22 setae, hind veins with 13 setae each. Hind wing typical of the genus.

Legs brown, femora lighter than tibiae. The usual claw present on fore tarsi. Thoracic area brown with light orange tint. Abdomen brown with segments II and III lighter. Shape of body as in fig. 9. Setae on pronotum small, uniform in size and more or less uniformly placed over entire surface. Sub-hypodermal pigment in body orange rather than red.

Measurements (in mm.): Antennal segments, length: I, .028; II, .049; III, .128; IV, .102; V, .038; VI, .070; VII, .057; VIII, .019; IX, .012. Head, length, .147; width, .176. Pronotum, length, .169; width, .217. Forewing, length, .837; width at narrowest portion, .074, at widest portion, .121, or 1.6 times as wide as at narrowest point. Total body length, 1.63.

Stomatothrips rotundus Hood, 1949

1949. Hood, J. D. Rev. de Ent. 20(1-3):10-12, figs. 7, 8.

This South American species is known only from the original collection. It belongs in that segment of the genus having 7-segmented maxillary palps. From its relatives it is distinguished by the dark-colored antennal segment IV and the broader head.

It should be noted that the two species of *Stomatothrips* described from South America have been collected from *Panicum* as have also *flavus* and *brunneus* in Texas.

A Key to Stomatothrips Species

1. Maxillary palpi 8-segmented 2
   Maxillary palpi 7-segmented 3
2. Antennal segment IV long and slender (.131-.147 mm. in female), usually pale yellow with brown ring at tip. Segment III yellow. Antennae of male very long and slender, all segments smoky brown. General body color yellow to light brown. (North America) ..... *flavus* Hood, 1912
   Antennal segment IV much shorter (.080-.092 in female), shaded with dark grey or brown at tip usually with more pigmentation than narrow ring at tip. Antennae of male bicolorous, segments II and III light yellowish brown, I darker, IV-IX dark brown and much shorter. General color brown to dark brown with crimson sub-hypodermal pigment..... (North America) ..... *brunneus* J. C. Crawford, 1940
3. Antennal segment IV white with black line around tip. Male unknown. (South America) ..... *angustipennis* Hood, 1949
   Antennal segment IV blackish brown..... 4
4. Forewing narrow and not strongly expanded in distal third (fig. 6). Ring vein pigmented along entire costal margin distally. Anterior longitudinal vein of forewing with 19-22 setae. Male unknown. (Central America) ..... *septenarius* Hood, 1925

Forewing expanded distally, greatest width 1.6 to 1.7 times the least width 5

5. Intermediate dark-colored portion of forewing without paler areas (as in figs. 6, 7, and 8). Antennal segments V and VI each with cuneiform sensory area; VII .041 mm. in length. (North America) ..... *atratus*, Hood, 1939

Intermediate dark-colored portion of forewing paler in basal third. Antennal segments V and VI each with a linear sensory area; VII .059 mm. in length. (South America) ..... *rotundus* Hood, 1929

CATALOG OF THE SPECIES OF STOMATOTHRIPS WITH NEW DISTRIBUTIONAL RECORDS

1. *angustipennis* Hood, 1949. South America: Brazil. Nova Teutonia, Santa Catharina, Jacarepagua; D. F., Campo Grande, R. J. Taken on grasses, *Panicum* sp., and dead branch. January, May, and June. Females only; both macropterous and micropterous.
2. *atratus* Hood, 1939. North America: San Antonio, Texas. *Lycium berlandieri*. March. Females only originally. New record: one male, October 3, 1948, at Winter Haven, Texas, ex *Lycium berlandieri* by K. Sakimura.
3. *brunneus* J. C. Crawford, 1940. North America: Lafayette County, Arkansas. Unique female "in peach orchard soil." October. New records: Monterey, Mexico, July 5, 1908. C. A. Hart. In sweeping from grass, etc. Intercepted in quarantine at El Paso, Texas. Other Texas records are from Bangs, Denison, Crystal City, Waco, and Winter Haven. Nogales, Phoenix, Patagonia, Sonoita and Sedona, Arizona. Mesilla, New Mexico. Calera, Oklahoma. Sioux City, Iowa. New hosts are: alfalfa, Bermuda grass, clover, cover crops, Johnson grass, grass, lettuce, *Panicum obtusum*, peach, yucca, and in soil. Collections have been from May through October.
4. *flavus* Hood, 1912. Genotype. North America: Monterey, Matamoras, and Tlahuailio, Mexico. Brownsville, Texas. Dubois and Odin, Illinois. Common on cotton, grass, and weeds. June to September. Both sexes. New records: Elkpoint, South Dakota. Nashville, Tennessee. Gorham, Eldred, Eichorn, Hoopeston and New Canton, Illinois. Baton Rouge, Louisiana. Toquerville and Brigham, Utah. Clifton, Glendale, Phoenix, and Tucson, Arizona. Imperial County, California. Rogers, Arkansas. Lawrence, Kansas. Texas localities of Temple, Crystal City, Carrizo Springs, Brownsville, El Paso (in quarantine station), Waco, Bexar, and Caldwell Counties. Four-mile Run, Virginia. Putman County, Georgia. The list of hosts now include alfalfa, *Andropogon*, clover, cotton, corn, *Malva rotundifolia*, grass, grape, *Panicum obtusum*, partridge pea, peach, turnip, weeds, and in soil. Collection dates extend from April through November. The micropterous form is known from Illinois.
5. *rotundus* Hood, 1949. South America: Brazil. Nova Teutonia, Santa Catharina. *Panicum* sp. January. Both sexes.

6. *septenarius* Hood, 1925. Central America: Trinidad and St. Thomas (B.W.I.). Grass sweeping. Females only. March 29, 1915. New record: La Ceiba, Honduras. July 15, 1949. Flying. E. C. Becker, Coll. This specimen is in the collection of the Illinois Natural History Survey.

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RECORD OF STENOMORPHA CONSOBRINA FROM WASHINGTON AND OREGON

(Coleoptera: Tenebrionidae)

Twenty-seven species of this tenebrionid beetle were given to me by my friend Mr. Samuel Sargent, a geologist employed by the U.S. Engineers at The Dalles, Oregon. They were collected about a mile north of The Dalles, across the Columbia River in the state of Washington, December 15 to 21, 1951. This is a new record of this species for Washington. He also tells me that the beetles are quite common periodically in the area of The Dalles, Oregon, where they are usually found under stones; this is their first recorded occurrence in Oregon.—Borys Malkin, *University of Washington, Seattle.*

NOTES ON TELEGEUSIS AND SOME RELATIVES

(Coleoptera, Lymexylidae)[1]

H. S. BARBER[2]

Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture

Two small, slender, pale beetles having very short elytra and long sensory extensions on the labial and maxillary palpi came to our old oil lantern in Castle Creek Canyon near Hot Springs (40 miles northwest of Phoenix), Arizona, in late June, 1901, and the enigma of their significance as then explained by E. A. Schwarz was very impressive. He and H. G. Hubbard had taken another species of this genus near Tucson and at Fort Grant three years previously, and only Horn's record of the single specimen from the tip of the Lower California peninsula was then known. Later a specimen in the Horn collection in Philadelphia was mistakenly believed to be the type, but it and our samples were extremely unlike the figure published by Horn in 1895 (Proc. California Acad. Sci. vol. 5, pl. 20, fig. 1). New illustrations and notes were made, but it became clear that until more adequate samples and data were available the naming of "new species" would merely confuse the involved issues.

Horn had placed *Telegeusis* in the Drilidae, in which family it was catalogued by Olivier, 1910 (in Junk, Coleopterorum Catalogus, part 10, p. 9). My suspicion that *Telegeusis* is a very close relative of *Atractocerus* in the Lymexylidae, as stated in 1913 while considering affinities of *Micromalthus* (Proc. Ent. Soc. Washington vol. 15, p. 37), was supported by the late Fred Muir (in litt.) in time to record his finding in a footnote. Leng, 1920 (Cat. Coleop. Amer. north of Mex. pp. 31, 152), proposed the family name Telegeusidae, and later Leng and Mutchler, 1927 (Suppl. Cat. Coleop. north of Mex. p. 28), wrongly removed *Atractocerus gracilicornis* Schenkling, 1914, from Lymexylidae and placed it in Telegeusidae. Martin, 1932 (Pan-Pacific Ent., vol. 8, p. 91), gave the name *Telegeusis nubifer* to two specimens from southern Arizona, as distinct from *T. debilis* Horn; the types of both are preserved in the California Academy of Sciences. Schenkling, 1934 (in Junk,

[1]Leng's use of Lymexylidae is correct and reappears in the catalogue by Winkler 1925, but Lymexylonidae is still used in foreign papers. Dr. Roland Brown tells me the Greek word xylon is neuter and calls for the shorter spelling under the Rules.

[2]Mr. Barber died on June 1, 1950.

Coleop. Cat., part 133), adopted Telegeusidae from Leng, including only the two species but did not refer to Olivier, 1910, nor to Barber, 1913.

Much additional material was accumulated by various collectors, but the uncertainties remained very discouraging. The present note results from the kindness of Dr. E. C. Van Dyke in placing the type specimens of both named species of *Telegeusis* before me and, after 47 years of doubt, it was a great satisfaction to learn how closely Horn's type specimen agrees with the figure he had published.

Most of the facts of life of this genus are still unknown, and until a better method for preparing such delicate forms can be applied to new samples little more than taxonomic guessing can be expected. Nearly forty males came to the lantern on June 17, 1949, in Baboquivari Cañon (50 miles southwest of Tucson) Arizona, during a short period before a windstorm, and were rapidly collected in an aspirator by Dr. Floyd G. Werner. They were killed in ethyl acetate vapor and preserved in 70% alcohol. Much of the shrinkage and collapse of their structure so objectionable in ordinary specimens was thus prevented. After they had been dehydrated in absolute alcohol, cleared in xylene, dried, and mounted, very superior specimens were available, but, if a method of distending such specimens can be applied before they are fixed in alcohol, still better samples might be obtained.

This and other series preserved by various collectors indicate the abundance of these beetles at their time of flight. But as yet no association of sexes, no breeding place, no larvae, and no biology are known. No female has been recognized, and all specimens in collections are probably males. The sex of the type of *T. debilis*, which Horn believed to be a female, could not be positively ascertained without relaxing it, but the visible terminal segments seemed identical in shape with specimens known to be males.

The following hypothesis may stimulate better investigation.

The very few and too little-known species comprising the primitive family Lymexylidae of wood borers have survived as "living fossils," but have undergone very divergent structural modification adaptive to their extremely different habitats and habits both in their adult and larval forms. The feeble soft-bodied ship-timber beetle *Lymexylon navale*, which bores in oak in northern Europe,

retains its beetle-like structure with long elytra covering transversely folding and normally veined underwings; the related genus *Atractocerus* of tropical forests, whose larva resembles that of *Lymexylon*, has reduced its elytra to vestigial appendages and has developed strong longitudinal venation without transverse folds. *Atractocerus* flies like a hawk moth, and in some species vertical and horizontal rudders have developed in the form of a large midventral lamella and lateral expansions of segments 8 and 9 of the very flexible abdomen. *Telegeusis* is a dwarfed, depressed, and simplified relative of *Atractocerus* modified to its life in the Sonoran desert region. Its breeding place is probably in the roots of desert plants. Its depressed form, small size, and pale color are necessary adaptations to this habitat and enable the males to seek out their yet unknown mates which probably remain close to the roots in which they matured. These beetles are abundant from Cape San Lucas to central Arizona.

But who will dig them out, recognize their larvae in their galleries and learn if, like so many other plant borers, different species are peculiar to different host plants? For, as is repeatedly evident in our work, species (i.e., self-perpetuating populations isolated by some vital barrier from related but similarly isolated populations) may be more distinct in their hereditary chemitropic controls than in visible structural differences. As yet, we have from such populations only relatively minute samples consisting mostly of shrunken and mummied individuals without any reliable comparative vital data.

Too little is known of the aedeagal structures of the Lymexylidae, and it is unfortunate that the latest contribution (Jeannel and Paulian, 1944, Rev. Francais d'Ent., vol. II, fasc. 2, p. 77, fig. 19) illustrates what seems to be the somewhat mutilated female structures (ovipositor) of *Atractocerus brevicornis* as if they were the genitalia of the male. Figures 46 and 47 on p. 83 of this work seem also to have been drawn from the female (ovipositor) and do not represent male structures (aedeagus) of *Ripiphorus* (which they call *Myodytes subdipterus*). Sharp and Muir, 1912 (Trans. Ent. Soc. London, p. 542, pl. 66, figs. 149, 150, 150a), had already given excellent diagrams showing aedeagi of two species of *Atractocerus*, but great modification of the median and lateral lobes is evident in the few males of other species which are available in the United

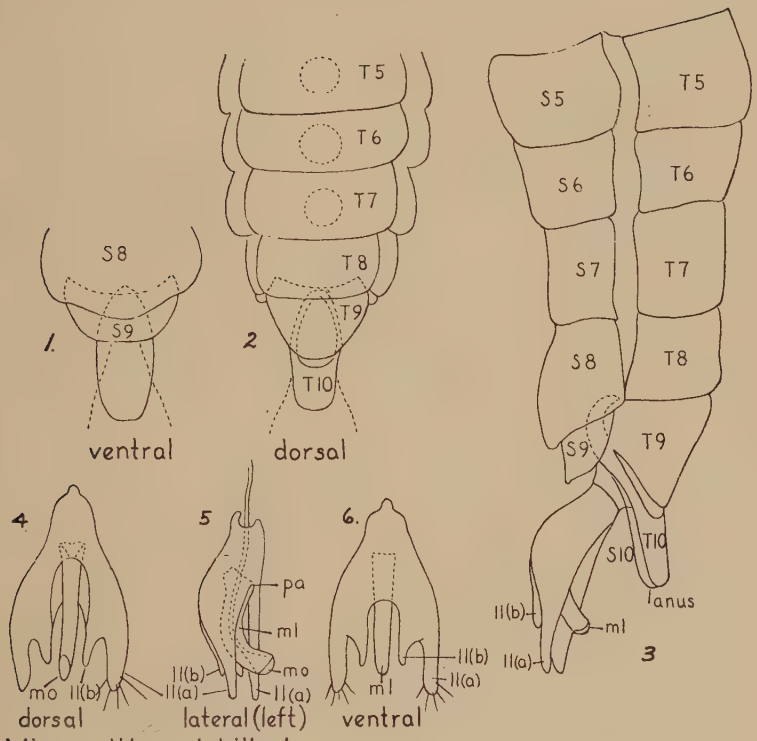
States National Museum. Drawings of the aedeagi of *Telegeusis nubifer* and of *Micromalthus debilis* made by the late F. Muir and sent to me shortly before his death are here offered (fig. 1-9). The abbreviations labeling the parts are those adopted by Sharp and Muir, 1912 (*op. cit.*, p. 481, 482) except that the letter "a" indicates the medially produced and united inner process from the bases of the lateral lobes, similarly indicated as "a" in their treatment of *Atractocerus africanus* (*op. cit.*, p. 542, and fig. 150).

The aedeagi of *T. nubifer* and *schwarzi* are similar, but different preparations appear different according to extent of shrinkage or inflation. The long dorsally concave or flattened apically-rounded lateral lobes appear to embrace the apically-pointed, basally broadly-expanded midventral lobe (indicated by *a*) which arises from the inner bases of the lateral lobes; the side margin and apex of this lobe is raised into a sclerotized carina, within which the upper surface is deeply recessed and membranous; out of this recess arises the slender strongly upturned and curved median lobe with its small subapical ventral functional orifice.

The modified alar venation of *Atractocerus* and of *Telegeusis* appear comparable and derived from the primitive venation of *Lymexylon*, the differences between the first two being such as are necessary for the swift and powerful flight of *Atractocerus* in contrast with that of the feeble Sonoran form.

It is not rare that functional sensory organs by which males are guided to their mates become highly developed and complex in larger and more active forms, as in the maxillary palpi of several genera in this group. The development of similar sensory surfaces on both the enlarged maxillary and labial palpi in *Telegeusis* should not be surprising. It should be remembered that the complex plumose sensory structures of the maxillary palpi of *Hylecoetus dermestoides* Linnaeus, in which the antennae are simple, are absent, in *H. flabellicornis* Schneider, in which similar sensory organs are developed in the antennae which have become biramose. These modifications have been shown very clearly by Germer, 1912 (Zeitschr. f. wissenschaft. Zool. Bd. 101, Heft 4, pp. 683-735).

Opinions on family rank have commonly been based upon structural peculiarities supposed to isolate such units from all related forms, and the peculiarities so obvious in *Telegeusis* in-



Figs. 1-6, *Micromalthus debilis* Leconte. Figs. 1-3, ventral, dorsal and lateral views of part of abdomen of male. Figs. 4-6, dorsal, lateral and ventral views of aedeagus of male. Figs. 7-9, *Telegeusis nubifer* Martin, ventral, lateral and dorsal views of aedeagus of male.

duced Leng, 1920 *(op. cit.,)*, to propose a new family name for it although he left it doubtfully in the superfamily Lymexyloidea. The great adaptive diversity so conspicuous in the few known stages of the very dissimilar genera and species composing this group presents a problem on which opinions will probably continue to differ and will induce conflicting explanations of anatomical details. This diversity is even more complicated by recent reassignment of *Micromalthus* to the Lymexylidae, and if this be accepted the larval modification becomes much more complicated.

But I am surprised at the misinterpretation of the real structure of the leg of first stage *Micromalthus* larva (Jeannel and Paulian, 1944, *op. cit.*, p. 79, fig. 23). In this stage the long tarsus and two claws seem to have survived from the ancestors of the Coleoptera, while all other families, except carabid relatives, have simplified and more or less consolidated these primitive appendages. A distinct tarsus and one imperfectly consolidated claw seem to be present in *Hylecoetus* as well as in *Melittomma*, but in the latter the pair of enlarged spines on the tip of the tibia seem to have been mistaken for lobes of the supposedly consolidated tarsus and claw. One should consider, however, that such comparison of structures of first-stage larvae *(Micromalthus)* with those in advanced larvae of a very different genus *(Melittomma)*, even if the structure were correctly understood, may not be a sound method. We know the first-stage larva of *Hylecoetus* only from the figure by Germer, 1912 *(op. cit.*, pl. 30, fig. 5), in which the leg structure is not clearly shown.

The drawing by Fulmek, 1930 (Treubia, vol. 12, p. 391), is not clear as to leg structure, but illustrates an apically bidentate pygidial plate (tergite 9) in the first-stage larva of *Atractocerus emarginatus* Castelnau. Embryos extracted from eggs laid by a Guatemalan *Atractocerus* show a pointed, broadly triangular pygidial plate (T 9) with long hairs arising from the margin on each side of the apex and with the margin strongly serrate towards its base, legs conventional in form with single claw. The differences between first-stage larvae and those which follow are often great, and attempts should be made to hatch eggs laid by freshly captured females of such interesting and problematical forms.

The affinities of adult *Telegeusis* and *Atractocerus* seem obvious, and similar affinities of larvae of *Atractocerus* and *Lymexylon*

suggest there is no need for a supergeneric name based on *Telegeusis*. Comparable structures in adults of *Telegeusis* and *Micromalthus* might be used to place the latter in the same family, but its highly specialized larval forms do not seem to permit such assignment, and the statement (Jeannel & Paulian, 1944, *op. cit.*, p. 79) that obdominal segment 10 is the same in larvae of *Micromalthus* and *Melittomma* seems to be not true in our samples of these forms. Relationships have been discussed with John R. Bowman, whose evidence indicates *Micromalthus* as the closest relative of *Telegeusis*. The problem cannot be solved, however, until more exact details are available for the various larval stages of the comparatively few genera of these isolated survivors from a primitive ancestral stock.

TELEGEUSIS DEBILIS Horn, 1895, Proc. Calif. Acad. Sci., ser. 2, vol. 5, p. 242, pl. 20, fig. 1; Martin, 1932, Pan-Pacific Ent. vol. 8, p. 91, genotype, monobasic.

The holotype and only known specimen of this species, labeled "Sierra San Lazaro," preserved in the California Academy of Sciences and marked as Lectotype No. 32, is in relatively good condition and agrees surprisingly well with the rather crude original illustration by Horn. It is slender, entirely pale yellow (perhaps a little faded), with head one-half longer than the pronotum which is slightly transverse, three-fifths as wide as elytra and four-fifths as wide as the distance across the eyes. The elytra are narrow, tapering and long, extending one-third of their length beyond the hind coxae; the abdomen plainly shows 9 tergites and what may be the tip of tergite 10 (anus?) projecting from beneath the narrowly rounded pygidium (T 9) as a subcylindrical slightly tapering narrow tube; 8th visible sternite (S 9) is longer than wide, transversely convex and apically rounded. The side margin of the head from the hind margin of the eye to the cervical membrane is one and one-half times the length of the eye.

Horn believed this specimen was a female. When I examined it in July, 1948, its sex was not apparent, but subsequently studied males of other species, in which the aedeagus is concealed within segment nine, display apical segments in agreement with notes I made from this type.

TELEGEUSIS NUBIFER Martin, 1932, Pan-Pacific Ent., vol. 8, p. 91.

I apply this name to the numerous specimens from Arizona and Lower California which show more or less infuscation, and short elytra extending to above the apex of the hind coxae. It is not now practicable to attempt division of this assemblage. Much better evidence than is now available should be obtained.

The holotype (No. 2467, California Academy of Sciences) is labeled "San Pedro Riv. Fairbanks, Ariz., Sept. 6, 1927, J. A. Kusche."

Telegeusis schwarzi Barber, new species

Entirely pale yellow except eyes and palpi, elytral apices and posterior margin of pronotum whitish; elytra only about one-seventh longer than their combined width across humeri, their apices reaching only to lateral base of hind coxae and more broadly rounded than in *T. nubifer*. Length 5 to 8 mm., dry. The caustic treated specimen mounted in balsam distended to 10 mm.

Holotype and three paratypes: U. S. National Museum Cat. No. 59816. Holotype (slide) and one paratype: Hot Springs, Arizona, 26 and 27 June, 1901, collected by E. A. Schwarz in memory of whom the species is named. Three paratypes: Globe, Arizona, July 3, 1949, F. G. Werner, one of them returned to Werner.

Very similar to *T. nubifer* but paler, slightly broader, the antennal joints slightly stouter, the sides of the pronotum more deeply emarginate at middle, the gula narrower.

The simple differences suggested in the following key do not apply entirely to certain males which are tentatively regarded as variants of *T. nubifer*. The very wide area occupied by what seems to be this most abundantly represented "species" may be misleading owing to the present inability to distinguish actual species among the shrunken and distorted males. If the as yet unknown females are sedentary in their habits or are, by inheritance, attracted to different kinds of host plants for oviposition, we will need a different taxonomic treatment of species.

Key to the Recognized Species of Telegeusis

1. Elytra tapering, narrow, subacute and long, extending one-third their length beyond the hind coxae; head much longer than the pronotum. Sierra San Lazaro, Baja California (? 10 mi. NW. of San Jose del Cabo) ..... *T. debilis* Horn

   Elytra short, arcuately truncate, not passing apex of hind coxae; head but little longer than pronotum 2

2. Elytra reaching apex of hind coxae or about a third longer than their width across humeri, their apices infuscate. Arizona and Baja California ..... *T. nubifer* Martin

   Elytra shorter, their apices reaching only to base of hind coxae and not infuscate, the width across humeri nearly equal to elytral length. Central Arizona ..... *T. schwarzi* Barber

DESCRIPTION OF A NEW ARIZONA THAUMAGLOSSA

(Coleoptera: Dermestidae)

R. S. BEAL, JR.
Denver, Colorado

In the course of a study of the Dermestidae the writer found five specimens of a remarkably distinct species of *Thaumaglossa* Redtenbacher, which species is named and described as follows:

Thaumaglossa libochoras Beal, new species

Adult male: Strongly convex, ovate, widest at humeri, rust-red on all surfaces; vestiture in length about three-fifths as long as scutellum, golden-brown, evenly distributed, moderately fine and moderately dense, suberect on dorsal surfaces, subrecumbent on ventral surfaces. *Head* in width (measured across eyes) closely approxmating length of pronotum; punctures of front and clypeus round, shallow, about two and one-half times as coarse as facets of eye, nearly contiguous, becoming somewhat smaller and less dense on vertex; width beween fossae for insertion of antennae closely equal to distance from distal margin of clypeus to basal margin of fossae; antennae with scape and funicle sparsely clothed with fine setae, eleventh segment densely clothed with fine, erect puberulence about equal in length to sixth antennal segment, configuration of antenna as illustrated, eleventh segment in repose extending over lateral lobe of prosternum as far as middle of procoxa. *Pronotum* with punctures of disc simple, equal in coarseness to facets of eye, separated by one to three diameters, becoming larger and nearly contiguous toward sides, surface between smooth and shining; ratio of length to width 1:2.1. *Elytra* with punctures of disc twice as coarse as facets of eye, separated by about one diameter with margin of each very slightly raised above surrounding surface, surface between feebly rugose and shining; ratio of pronotal width to elytral width at humeri 1:1.1. *Prosternum* deeply, coarsely, and confluently punctate on disc without impunctate median line, becoming granulate-punctate on sides. Antennal fossae occupying entire hypomeron; antero-lateral and posterior margins knifelike, evenly produced, and extending entire length of fossa; fossae completely open (without margins) medially; floor of cavity glabrous and shining, transversely strigose except for short longitudinal strigose lines along posterior wall. Mesosternal disc with punctation about as prosternal disc. *Length* (of pronotum and elytra): 3.1 mm.; *width* (across humeri): 2.1 mm.

Adult female: Color of head and pronotum piceous-black, elytra piceous-black except for rufo-piceous apical margins, thorax piceous, abdomen, antennae, and legs reddish-brown. Eleventh segment of antenna small, scarcely wider than tenth and about twice as long as length of ninth and tenth segments combined. Hypomeron margined as in male, but without fossa for reception of antenna, surface flat and coarsely punctate except for small impunctate depression at middle of medial margin, this depression not at all margined. *Length* (of pronotum and elytra): 3.8 mm.; *width* (across humeri): 2.6 mm.

Holotype: Male (in collection of Ohio State University) collect-

ed at PALMERLEE, ARIZONA, July 14, 19-?, by H. A. Wenzel; *allotype* female, same, July 11; female paratype, same, July 16; male paratype, same, July 10 (allotype and female paratype in collection of Ohio State University, male paratype in author's collection); one female paratype, Santa Rita Mts., Arizona, Hubbard and Schwarz (in collection of U. S. National Museum).

While clearly distinct from all known members of the genus, *libochoras* belongs to *Thaumaglossa* as now defined, having the strongly convex, ovate shape, the two, small, short, diagonal, impunctuate areas on either side of the basal lobe of the pronotum, the completely divided mesosternal disc, and the oblique diagonal striae of the first abdominal segment, the male having the one extremely large, subsecurriform, terminal, antennal segment, and the female having the flat but acutely margined hypomeron. It is undoubtedly most closely related to the other nearctic species, *americana* (Jayne), from which it differs most noticeably in the shape of the male terminal antennal segment, in the relatively denser punctation of the pronotum, and in its larger size. In specimens of *americana* measured by the writer the males vary in length from 1.9 mm. to 2.6 mm., the females from 2.2 mm. to 2.7 mm. While the color of the specimens above is uniform, color here as a character is probably neither reliable nor constant, the color of *americana* varying over a wide range.

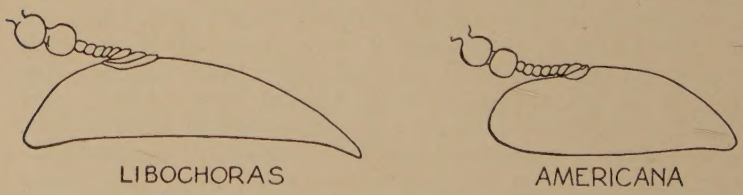


Fig. 1. Antennae of males of *Thaumaglossa*.

From the oriental *rufocapillata* Redtenbacher, type of the genus, both *libochoras* and *americana* differ markedly, the first species having at the antero-median angle of the hypomeron of the female a round, deep, and strongly margined fossa into which the antennal club exactly fits, and having an appreciably narrower separation between the fossae for the insertion of the antennae on the head. These characters hold likewise for two other oriental species seen by the writer, *nigricans* MacLeay and *hilleri* Reitter, and in any future revision of the genus should be carefully considered as indicating the divergence of our American species.